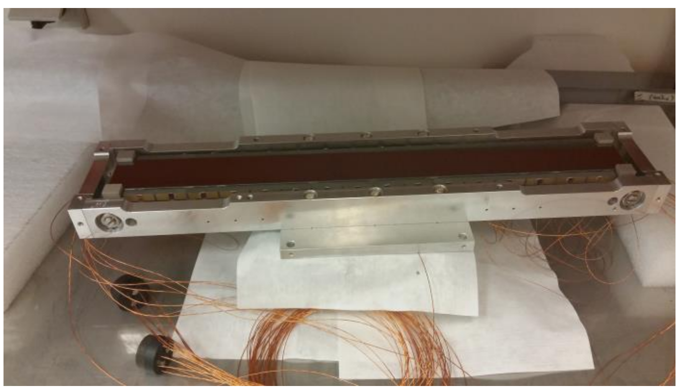
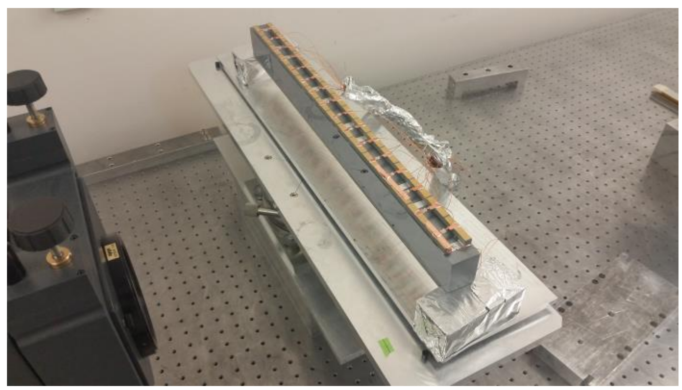
NSLS-II Experimental Tools (NEXT)

February 2016 Project Activity

Report due date: March 20, 2016


SMI: Compound refractive lens transfocator installation at 12-ID-C

SMI: Bi-morph focusing mirror during final assembly and testing at the supplier's (Thales-SESO) site

Steve Hulbert
NEXT Project Manager

BROOKHAVEN NATIONAL LABORATORY

OVERALL ASSESSMENT

February 2016 was one of the peak Photon Delivery System (PDS) installation months for NEXT. Most of the remaining PDS components for ISS were installed during February and PDS installation at ISR began in the 2nd week, with significant progress made by the end of the month. PDS installations at ESM and SIX also made good progress this month, and endstation installation at ESM began. At SMI, preparations were made for delivery of most of the remaining PDS components, expected in March.

The IRR for the SMI ID and FE was completed successfully on February 22 and commissioning began on March 2. Preparations for the ISS PDS IRR continued in February, remaining on track for this review to be held on March 24.

As of February 29, 2016, the project is 77.4% complete based on base scope performance earned to date. The cumulative EVMS schedule and cost indices both increased by 0.01 in February, to 0.96 and 0.95, respectively.

Three PCRs were approved during February: one for EPU procurement contract amendments and adjustments, a second for amendments to two ISS procurement contracts, and a third to implement revisions to Level 2 and Level 3 project schedule milestones. The net cost impact of these PCRs was to increase BAC by $5k.

Monitoring and management of contractor progress on the 32 remaining major procurement contracts are important ongoing activities that are crucial to maintaining project schedule.

BAC remained flat in February at $82.3M. Cost contingency is reported at $7.7M, which represents 41.4% of $18.6M BAC work remaining. The EAC, reported as the sum of actual cost to date (ACWP) plus the estimated cost to complete (ETC), is $85.74M, nearly the same as in the January EAC value. As of the end of February, contingency on EAC is $4.26M, which represents 23.0% of $18.5M EAC work remaining. Outstanding commitments total $10.6M, so the $4.26M contingency on EAC represents 54.3% of $7.9M unobligated EAC work to go. ETC will continue to be assessed monthly through project completion to contain costs while maintaining the good schedule performance that the project has demonstrated to date.

COMMON SYSTEMS

NEXT mechanical and electrical utilities finishing work continued in February. Installation of cable trays in the SIX satellite building awaits further definition of the SIX spectrometer arm interfaces, expected in March. This month, the fire suppression plumbing for the gas handling system in the ISR 4-ID-D endstation hutch was completed by contract to Perfect Plumbing.

PPS design, development, and installation continued to make significant progress this month. The ISS PPS was fully certified on February 9. PPS installation activities continued at ESM and ISR. At ESM, an additional photon shutter was installed for the second beamline branch and PPS hardware integration began. The ISR and ESM beamline PPSs are scheduled to be certified during the May 2016 maintenance period.

The EPS team is continuing to receive EPS requirements for each beamline, and their efforts are being directed to where major beamline component installations are underway or soon will be taking place. At ISS, EPS installation made good progress this month, now that most of the photon delivery system components are in place. Testing of the system is now in progress, and all EPS work needed prior to the ISS IRR is scheduled to be completed in early March. At SMI, EPS technicians installed two temperature sensors for the white beam stop. Integration of the LN2 control valves into the ISR EPS was completed. EPS installation inside the ISR hutches will begin in early March, as Toyama finishes installation of the PDS components. EPS installation activities at ESM will resume in March following further installation of beamline components.

Control station configurations for all NEXT beamlines have been approved by the Light Source Safety and Operations Council (LSSOC), and remaining control station furniture at ISR and ESM is expected to be procured in April. Integration of AC power and network cables for all NEXT control stations is planned to occur over the next few months, after the control station partitions are received and installed.

BEAMLINE CONTROLS

Controls engineers continue to support optics and other component installation and testing at all NEXT beamlines. During February, motion tuning and testing was completed for the ESM M1 and KB mirror systems and the SIX M1 and M3 mirror systems. EPICS driver development was completed for several types of power supplies needed for ESM endstation controls. At ISR, a mobile motion control rack unit was provided to the Toyama team to support optics testing during installation. Also at ISR, networks were configured for controls installations. At ISS, six additional motion controllers were installed for endstation controls.

During February, the controls engineer at ISS was fully occupied with validating all PDS motions in preparation for the March IRR, as well as endstation controls development and testing.

As in the past, controls cable termination work continued at all beamlines to support controls deployment following optics and other component installations. ISR hutch 4-ID-C cable termination was completed in February, and ESM instrument side cable termination continued.

ESM – ELECTRON SPECTRO-MICROSCOPY

ESM construction activities continued at 21-ID during February. The main activities this month were: initiation of the bake of the M1 mirror system, completion of the bake of the KB mirror system, installation of more diagnostic units, installation of two downstream photon shutters (one per branch), and receipt of the M4 hexapod chamber.

The KB mirror system, which was installed at ESM in January, was baked for three weeks in February to achieve ultra-high vacuum. The final pressure with optics and diagnostic units installed is 5.7×10^{-10} Torr and is very close to the specified value of 5.0×10^{-10} Torr.

Following installation of more diagnostic units during February, the ESM beamline section between the FOE and the PGM monochromator is complete, under vacuum, and being baked to achieve ultra-high vacuum.

The layout of the ESM beamline includes a photon shutter located downstream of the monochromator. Its function is to allow short duration endstation activities that do not require synchrotron radiation (typically sample change) to be performed while the SR beam is kept impinging on the M1 and monochromator optics for thermal stability. Downstream of the monochromator, the beamline is split into two branches by using either the M3A or the M3B mirror. In order to permit independent operation of the two branches, another photon shutter has been installed downstream of the exit slit for each branch (Figure 1). In this way, it will be possible to vent one of the two endstations (for repair or modification) while maintaining full (and PPS-safe) operation of the other branch.

Figure 1: ESM: downstream shutters installed to allow independent operation of the μARPES and XPEEM branches.

The M4 refocusing mirror system for the XPEEM branch was received and positioned at 21-ID during February. Installation (without optics) and alignment are scheduled to be completed in March. M4 is the final optical component system to be received for the ESM beamline. At the end of February, all optical elements for ESM are in house except the M3B and M4 mirrors, which serve the XPEEM branch. Deliveries of the M3B and M4 mirrors are expected in March and May, respectively.

In March, installation of the monochromator optics (M2 mirror and four diffraction gratings) is planned.

ISR – IN-SITU AND RESONANT HARD X-RAY

The preliminary design of the ISR control station was approved by the Light Source Safety and Operations Council (LSSOC) on February 4, and the drawing of the egress aisles was released on February 17. The ISR Team met with the Control Station CAM on February 19, and specifications for the main control station area outboard of 4-ID-C were given to the Control Station CAM on February 26.

Preliminary ray tracing, beamline layout details, and models of masks, collimators, and secondary bremsstrahlung shields were given to the NSLS-II health physicist for radiation safety analysis calculations. Final design and fabrication of the secondary bremsstrahlung shields will commence after receipt of the radiation shielding report, which is expected in early April.

The mis-steer protection flange and one of the monochromatic beam masks were received. Hardware to secure the changeover stands inside 4-ID-C was also received, and the upstream components were installed. Vacuum terminations in the FOE and anchor installation for Shielded Beam Transport System stands were completed during the first week of February.

The Gas Handling System components arrived on February 1, and installation by Applied Energy Systems began on February 4. By the end of February, all enclosures, both gas cabinets, two racks, internal and external alarm beacons, wiring interconnect conduits, and two control panels— for the mass flow controllers and for the safety system— had been installed, along with piping between enclosures, gas cabinets, and racks (Figure 2). Piping between one of the gas cabinets and the laser was also installed, and sprinkler pipe was routed through the LN2 labyrinth in the roof and connected to the enclosures. The remaining installation work, which includes the exhaust system, is expected to be completed in March.

The HFM and VFM mirrors arrived on February 4, and were tested in the NSLS-II optics metrology lab during February 16-26. A Toyama technician installed the mirrors in their benders (see Figure 3, top), and an iterative process was carried out with the VFM in order to set the appropriate gravity compensation using springs. Slope errors were measured as a function of bending radius for both mirrors, and the calibration of the bender force to bending radius was determined (see Figure 3, bottom). Two target bending radii were specified for each mirror in order to focus to the Secondary Source Aperture (SSA) or to the sample position in the Instrumented 6-Circle Diffractometer, and both benders easily reached their two targets, exhibiting little hysteresis. The HFM and VFM will be placed inside their vacuum chambers after the latter are installed at the beamline and baked.

Twenty-one crates containing the FOE Optical Components Package, the Double Harmonic Rejection Mirror (DHRM), the SSA, the KB Mirrors vacuum chamber, and the Shielded Beam Transport System arrived on February 8. Staging the containers at the beamline and unpacking them took approximately one week, and installation by Toyama started in earnest on February 16. Suzuki Shokan, the subcontractor for the cryocooler, arrived and began installation on February 18. As depicted in Figure 4, significant progress was made by the end of February: radiation safety components were pre-surveyed; all floor plates were aligned and grouted; stands for the differential pumping assembly, second mask and collimator, HFM, beam stop unit, ion pump enclosures, BPM3, and the DHRM and SSA were installed; and the DCM and cryocooler were installed, connected, and successfully tested. Toyama will continue the first phase of their installation through March 19.

The ISR Team held a teleconference with Huber on February 23 to discuss the status of the Dual Phase Plate Assembly. The BNL-owned vacuum equipment (ion pump power supply, vacuum gauge controller, and associated cables) were received at Huber on February 16, but PINK, the subcontractor for the vacuum chamber, subsequently discovered a welding leak when baking the chamber. In order to minimize schedule delays, the ISR Team decided to revise the order of FAT testing. The ISR Team will travel to Huber to carry out detailed motion testing— with the Geo Brick motion controller and including measurements of the sphere of confusion for each circle— during March 3-4, prior to the vacuum testing. The assembly will then be shipped to PINK to complete vacuum testing, after which the Dual Phase Plate Assembly will be shipped to BNL for installation, which is expected to occur in early April.

Figure 2: ISR: Gas Handling System installation progress in hutch 4-ID-D, as of the end of February.

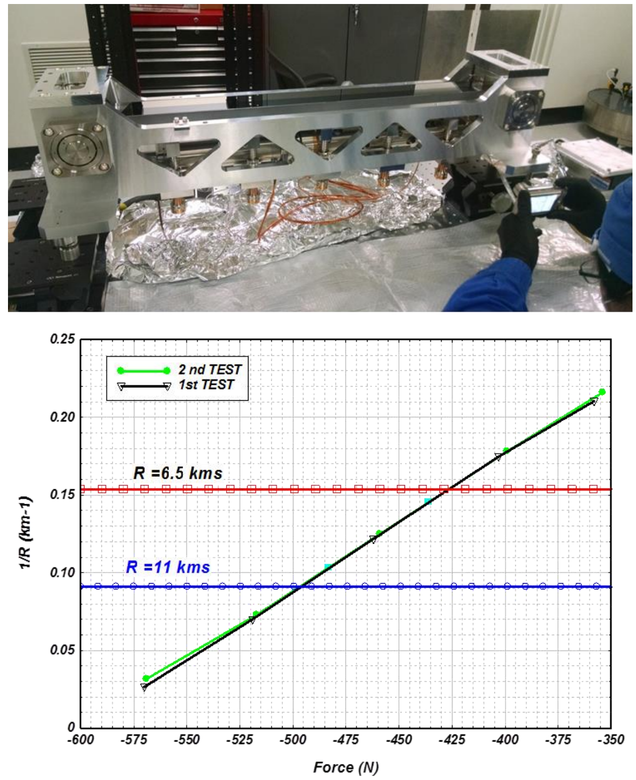


Figure 3: ISR: VFM being prepared for tests in the NSLS-II metrology lab (top), and results of VFM bender measurements (bottom).

Figure 4: ISR: FOE Optical Components Package, DHRM, SSA, and Shielded Beam Transport System installation progress. Clockwise from top left: staging of components outboard of 4-ID; cryocooler on the mezzanine; differential pumping assembly, and second mask and collimator stands in hutch 4-ID-A; grouted floor plates downstream of the DCM; ion pump enclosure between hutches 4-ID-A and -B; DCM in 4-ID-A; BPM3, DHRM, and SSA support in 4-ID-B; and differential pump enclosure between hutches 4-ID-B and -C.

ISS – INNER SHELL SPECTROSCOPY

During February, major progress was made in installation of the ISS PDS and its interfacing with utilities, EPS, and PPS. The collimation (Figure 5) and high heat load mirrors were installed and aligned, and all radiation safety components, including the secondary bremsstrahlung shields, were installed and surveyed into their final positions. In addition, the diamond BPMs were fully assembled, tested, aligned, and installed. The BPMs are controlled by the Programmable Logic Controller (PLC) of the EPS system. All PLC programming of these devices was performed, EPS thresholds and warnings defined, and full functionality tested.

The Instrument Readiness Plan (IRP), which captures all requirements and responsibilities necessary for successful completion of the IRR, was written and subsequently approved. Regular IRR preparation status meetings were held throughout February, with all support groups represented.

Approval of the IRP is an essential milestone on the path to the IRR completion. The IRP defines the three pillars for safe operation of the instrument: planning, installation, and appropriate training of personnel to operate the equipment.

The Radiation Safety Committee (RSC) review of ISS, one of the IRP requirements, was held at the end of the month. It focused on secondary bremsstrahlung calculations, ray trace drawings, and details of the manufacturing and installation of the radiation safety components. The RSC report, which advises regarding the appropriateness of all beamline radiation shielding and recommends any further changes, is an important piece of documentation needed for IRR.

At the end of February, the ISS team and all supporting groups were focused on providing all other documentation required by the IRP, in preparation for the March 24 IRR.

In addition to PDS installation and IRR preparation, progress was also made on the ISS endstation equipment. The FDR of the sample transfer system procurement contract was held. This system will provide a means to move samples from a glove box into the sample chamber without exposing them to air. The system design was evaluated and all safety aspects reviewed. It is expected that the production will begin in March.

Figure 5: ISS: Toyama installation team moving the collimation mirror, with its bender and cooling fixtures, from the clean tent installation area to the collimation mirror tank.

SIX – SOFT INELASTIC X-RAY

Further progress was made in February on final design of the SIX sample chamber (Bestec). A model of the triple rotating flange was received from Bestec's subcontractor, and was confirmed to fit within the interface control volume. The list of port sizes, positions, and angles for the chamber vessel was received and thoroughly checked. A request to add hole patterns on the sample chamber stand for mounting cameras and the sample transfer system attachment bracket was sent to Bestec. Another request, to clear an interference with the sample transfer system, was also sent. Both requests were satisfied.

The procurement package for two liquid-He sample-cooling cryostats was awarded to ColdEdge International in mid-February. One of these two cryostats is a closed-cycle device with a vibration-absorbing interface which will be connected to the sample holder on the Smarpod via braids ("cryostat A" in Figure 6). The second device is a flow cryostat ("cryostat B" in Figure 6), which will have the sample holder directly attached to the cold finger extension. It will be mounted inside a 5 DOF motorized manipulator which is included in the sample chamber procurement package with Bestec. The cryostat-A configuration will be used when priority is given to ease and accuracy of sample motions, while the cryostat-B configuration offers an improved cooling efficiency. Delivery of both cryostats is expected mid-June.

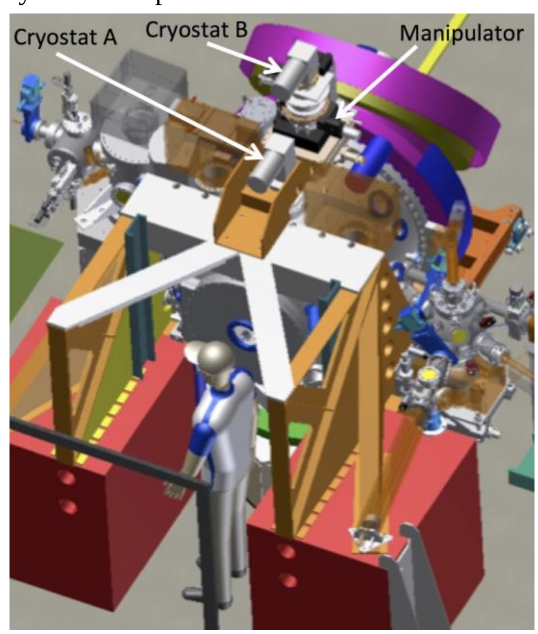


Figure 6: SIX: Rendering of the two liquid-He cryostats on top of the sample chamber.

The Bestec installation crew visited NSLS-II for about two weeks during February to continue installation of the M1 and M3 mirror systems (Figure 7). Significant progress was made during this visit. The M1 mirror was installed inside the chamber after performing metrology on the mirror mounted in its holder. Some mechanical parts found to be defective during the first phase of installation in December were replaced. The M1 chamber was baked and the vacuum is currently being tested. Survey was completed for the M3 mirror system, and the mirror was installed. No in-house metrology of the mirror mounted in its holder was performed, as the supplier's metrology shows that the surface figure meets specifications and the mirror is mounted for horizontal deflection (minimal gravity effect).

In the SIX satellite building, installation of AC power was completed: two 208V outlets were installed in the experimental area for bake-out carts, and 120V and 208V outlets in the mechanical room were installed for compressors (for the sample cryostats and detector) and for a roughing pump.

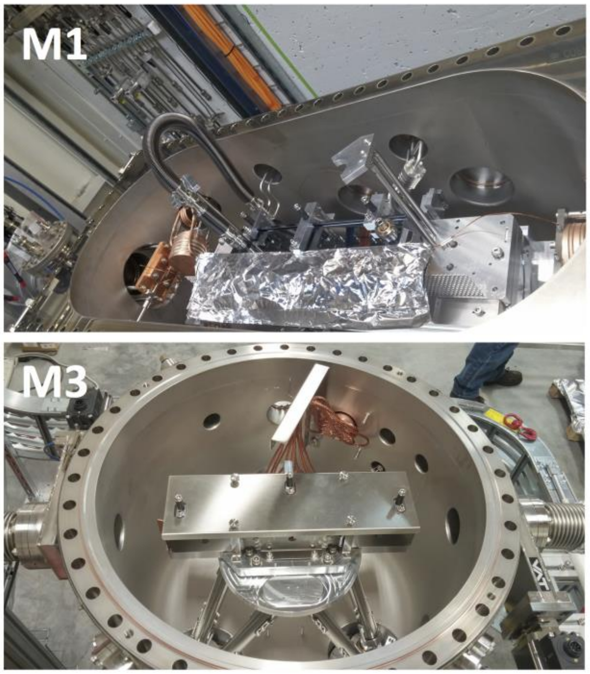


Figure 7: SIX: Interior of M1 mirror system chamber, showing the M1 mirror installed in its holder (top). Interior of M3 mirror system chamber, showing the hexapod, mirror holder, and cooling braids (bottom).

SMI – SOFT MATTER INTERFACES

During February, preparations were made for installations of several procurement packages scheduled to take place in March and April. Both of the SMI scientists traveled to Europe for a week, for a two-day FAT of the H-V Mirrors and SSA Package mechanics at Cinel, and for the second FAT at Thales-SESO (Cinel subcontractor) to approve the bimorph mirrors. At Cinel, key interferometry measurements were improved upon and re-performed, largely due to the expertise of Zhernenkov working side by side with the Cinel scientists (Figure 8). Mechanical stabilities of the mirror axis motions are now well documented. Input from NSLS-II's Vacuum Group also improved the vacuum measurement and performance of the mirror vessels. Under this guidance, Cinel pre-baked O-ring seals and established the optimal RGA measurement procedure (Figure 9). SMI also examined the details of the hutch 12-ID-B shielding stands and boxes, and required Cinel to demonstrate a rigging and hoisting procedure similar to that which will be used during the beamline's routine operations (Figure 10). Important communication was arranged with SMI engineers, BNL riggers, and the NSLS-II Installation Coordinator, both during the FAT and afterward, to finalize details about floor plans and in regards to moving granite bases over the 12-ID-B-1 door threshold during installation.

Figure 8: SMI: Associate Scientist Mikhail Zhernenkov (right) working with Dott. Giuseppe V. Lamanna, Head of Metrology at Cinel (left), on final interferometer measurements of SMI mirror mechanics stability and reproducibility.

Figure 9: SMI: HFM vessel shown during the FAT, with a clean RGA spectrum and pressure dropping steadily from 1E-7 Torr as the remaining water was pumped.

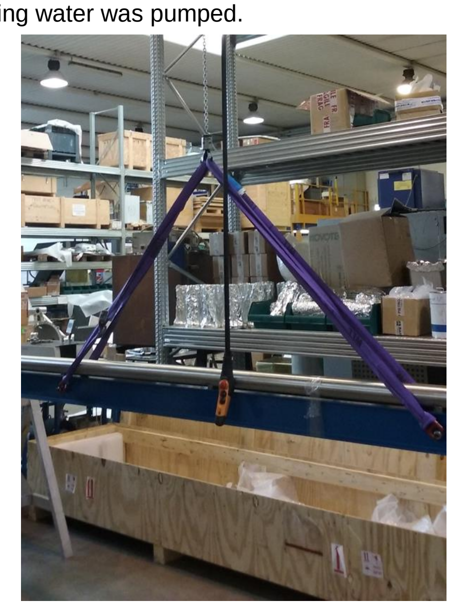


Figure 10: SMI: Cinel completed fabrication of the Removable Shielded Beampipe several months early, enabling shipping and installation together with the optical component portion of this procurement package. This photo shows how the pipe is lifted on its hoist points.

SMI scientists, accompanied by Riccardo Signorato from Cinel, witnessed and participated in surface profile metrology of the SMI VFM and HFM mirrors at Thales-SESO. The VFM meets the aggressive specifications for surface roughness, figure error, and bend radius range. SESO staff demonstrated how first order errors are removed from the mirror profile by application of voltages < 150V, and that the entire bend radius range is reached at applied voltages of order one-half the maximum allowable. The HFM is of extremely high quality, with one deviating region, a 20 nm “bump” only 25mm wide. The SESO team was eager to demonstrate that this 20-nm deviation could be removed by their ion profiling process within the SMI schedule, and this was approved and accomplished within February. SESO's remaining tasks include coating the mirrors, fabricating the drain current lead on the HFM Pt stripe as a diagnostic, and completing the documentation of applied voltage tables.

The CRL Transfocator from JJ X-ray was shipped in February, for early March arrival. JJ will arrive 10 March for on-time CRL Transfocator completion. Also during March, preparations will be made for installation of the PDS components from Cinel that are scheduled to arrive in early April, including survey and preparation of the hutch floors for the grouted bases and stands.

Progress on in-house SMI designs was also made during February. The Detector Vacuum Chamber was sourced in February, at a $6k savings compared to the estimate, and is in fabrication. The Sample Vacuum Chamber granite base was completed and shipped, for arrival in early March. Completion of the Sample Chamber mounting plate, upon which this granite base will be mounted, has been delayed owing to high demand from NSLS-II for work from BNL Central Shops. This delay will have knock-on effects for installation and testing of the sample chamber and interior components. There is additional work for SMI that will be going to Central Shops, including more than 100 part drawings for hutch 12-ID-B/C vacuum support and SAXS/WAXS mechanics; careful monitoring and oversight will be required to minimize schedule slippage. Examples of completed SMI endstation part designs (ready to be detailed, then fabricated) include those for the WAXS mechanics assembly, including detector brackets, hexapod base plate, and bounce-down mirror support (Figure 11), and for the XBPM mechanics (Figure 12). Anticipating that additional designer effort will be needed to create the associated build-to-print drawings, NEXT has approved some additional designer labor and overtime to help SMI catch up to the necessary fabrication schedule.

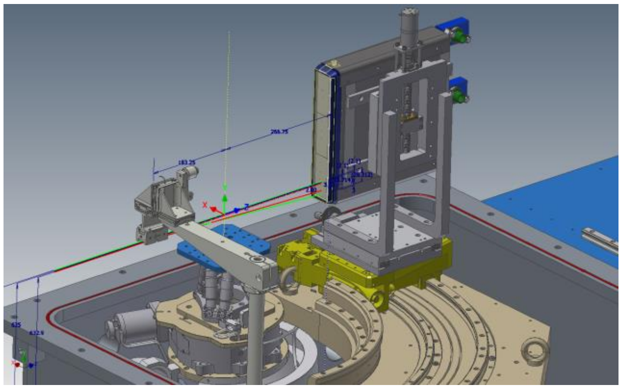


Figure 11: SMI: WAXS mechanics assembly showing completed models that have been handed off to designers to create prints for fabrication.

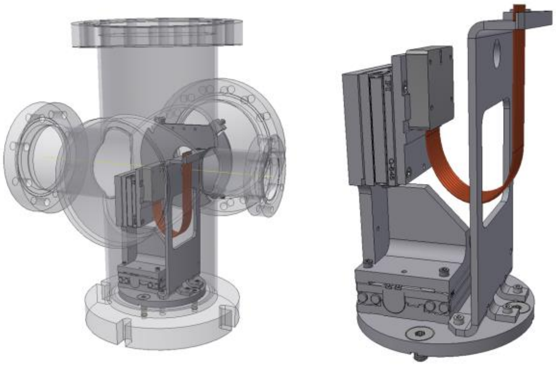


Figure 12: SMI: Models of SMI XBPM mechanics incorporating translation stages from PI for the X and Y translations. Left: assembly inside vacuum cross. Right: stages and support brackets, including strain relief for cables.

INSERTION DEVICES

After the successful completion of the Final Mechanical Acceptance Test (FMAT) and the Final Control Acceptance Test (FCAT) held in Slovenia in late January, Kyma prepared the SIX EPU for its shipment to BNL by sea. Figure 13 shows the crates for this shipment before leaving the Kyma site. The crates were transferred to Genova harbor on February 4 and the container left Italy on February 12, arriving in the US on February 27 for delivery to BNL in early March.

Figure 13: IDs: Wrapping and crating of the SIX EPU57 insertion device for its shipment by ship to BNL.

The third, and final, EPU insertion device for NEXT, a 2.8m-long EPU105 for ESM, is also being provided by Kyma. During February, Kyma reported that more than 100 of the magnets for this device were contaminated during the transport from the magnet supplier to the Kyma site in Slovenia. A photo of one of the contaminated magnets is shown in Figure 14. While Kyma and the magnet supplier are investigating the source and nature of this contamination, the contaminated magnets have been sent back to supplier for reconditioning. It has been agreed that to avoid similar incidents in future shipments, each magnet will be individually sealed in a hermetic bag. Despite the temporary loss of magnets, Kyma had enough permanent magnets to fully populate the ESM EPU105 and was able to run an optimization to sort magnets into modules. As shown in Figure 15, the optimization with the reduced pool of magnets provides similar result as a previous simulation performed with the entire set. Therefore, it was agreed with Kyma to assemble modules using this magnet sorting order. The assembly of the modules is schedule to be completed in March.

Figure 14: IDs: Photo of a contaminated magnet for the ESM EPU105 insertion device.

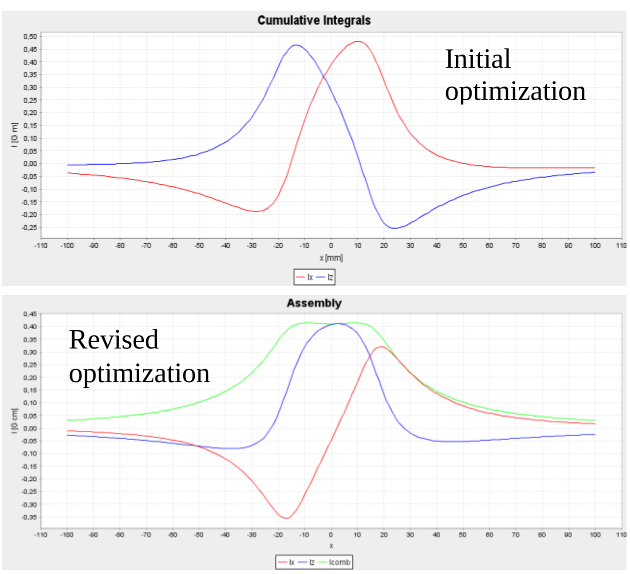


Figure 15: IDs: Field integral expected for the ESM EPU105 insertion device with initial optimization (top) and revised optimization using magnets available at Kyma (bottom).

The 1.4m long "turn-key" EPU57 for ESM which was delivered to BNL in the middle of January was moved to the magnetic measurement lab (Bldg. 832) at the end of January. As this device had been extensively characterized by Kyma prior to its shipment to BNL, field integrals and local field measurement were performed at only a small selection of gaps and phases to confirm their measurements. The good agreement between the BNL and Kyma measurements, shown in Figure 16, shortened the required measurement time in the BNL magnetic measurement lab to less than one month. The ESM EPU57 was moved out of the magnetic measurement lab during the last week of February for preparation (in Bldg. 832) for its upcoming installation in the 21-ID straight section. Transfer to the NSLS-II ring building is planned for mid-April.

The first of two planned EPU training visits from Kyma is scheduled for March 14-18.

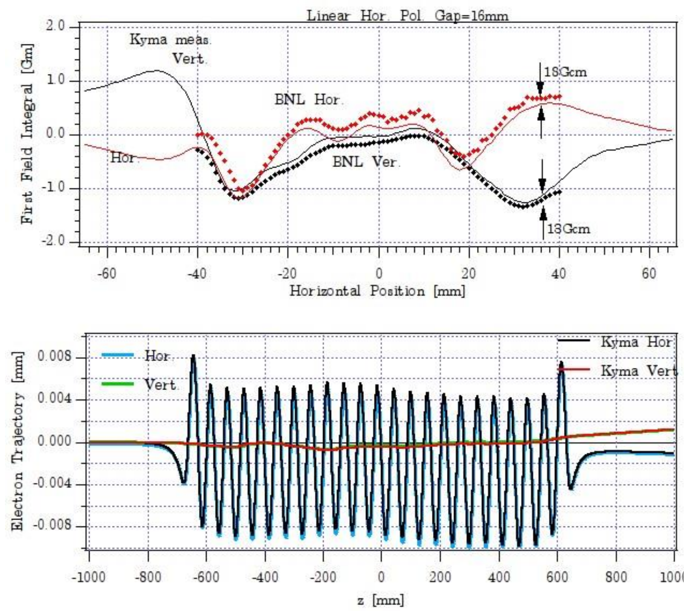


Figure 16: IDs: Comparison of the first field integral (top) of the ESM EPU57 insertion device measured at both Kyma (solid lines) and BNL (dotted lines) at 16mm gap and 0° phase. The computed trajectory of a 3GeV electron (bottom) in the magnetic field measured at Kyma.

PROJECT MILESTONES

Milestone	Planned	Actual
CD-0 (Mission Need):	May 27, 2010	May 27, 2010
CD-1 (Alternative Selection):	Sept. 30, 2011	Dec. 19, 2011
CD-2 (Performance Baseline):	Dec. 31, 2013	Oct. 9, 2013
CD-3A (Long Lead Procurement):	Dec. 31, 2013	Oct. 9, 2013
CD-3 (Start Construction):	Mar. 31, 2014	Jul. 7, 2014
Internal Early Project Completion – Beamlines	Oct. 14, 2016	
Early Project Completion:	Jan. 31, 2017	
CD-4 (Project Completion):	Sept. 29, 2017	

RECENT AND UPCOMING EVENTS

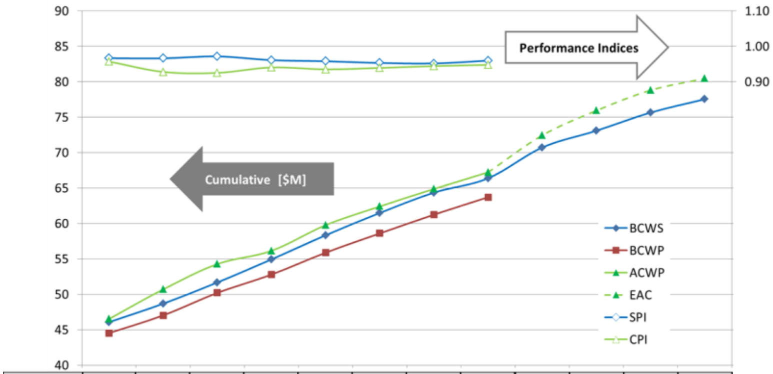
EVMS Desktop Review (BNL)	April 2016

Acronyms and Abbreviations

AC	Alternating Current
ACWP	Actual Cost of Work Performed
ARPES	Angle-Resolved PhotoElectron Spectroscopy
BAC	Budget at Completion
BCWP	Budgeted Cost of Work Performed
BCWS	Budgeted Cost of Work Scheduled
BNL	Brookhaven National Laboratory
BPM	Beam Position Monitor
CAM	Cost Account Manager
CD	Critical Decision
CPI	Cost Performance Index
CRL	Compound Refractive Lens
CV	Cost Variance
DCM	Double Crystal Monochromator
DOE	Department of Energy
DOF	Degree of Freedom
DHRM	Double Harmonic Rejection Mirror
EPICS	Experimental Physics and Industrial Control System
EPS	Equipment Protection System
EPU	Elliptically Polarizing Undulator
ES&H	Environment, Safety & Health
ESM	Electron Spectro-Microscopy beamline
ETC	Estimated Cost to Complete
EVMS	Earned Value Management System
FAT	Factory Acceptance Test
FDR	Final Design Review
FE	Front End
FCAT	Final Control Acceptance Test
FMAT	Final Mechanical Acceptance Test
FOE	First Optics Enclosure
FTE	Full Time Equivalent
FXI	Full-field X-ray Imaging beamline
FY	Fiscal Year
GHS	Gas Handling System
HFM	Horizontal Focusing Mirror
ID	Insertion Device
IRP	Instrument Readiness Plan
IRR	Instrument Readiness Review
ISR	Integrated In-Situ and Resonant X-ray Studies
ISS	Inner Shell Spectroscopy beamline
KB	Kirkpatrick Baez
LN2	Liquid Nitrogen
LSSOC	Light Source Safety and Operations Council
M&S	Material & Supplies
NEXT	NSLS-II Experimental Tools project
NSLS	National Synchrotron Light Source
NSLS-II	National Synchrotron Light Source ll
OPA	Office of Project Assessment
OPC	Other Project Costs
PCR	Project Change Request
PDS	Photon Delivery System
PGM	Plane Grating Monochromator
PLC	Programmable Logic Controller
PMAT	Preliminary Mechanical Acceptance Test
PMB	Performance Management Baseline
PPS	Personnel Protection System
RSC	Radiation Safety Committee
SAXS	Small Angle X-ray Scattering
SC	Office of Science
SIX	Soft Inelastic X-ray Scattering beamline
SMI	Soft Matter Interfaces beamline
SPI	Schedule Performance Index
SSA	Secondary Source Aperture
SV	Schedule Variance
TEC	Total Estimated Cost
TPC	Total Project Cost
UB	Undistributed Budget
VAC	Variance At Completion
VFM	Vertical Focusing Mirror
WAXS	Wide Angle X-ray Scattering
WBS	Work Breakdown Structure
WS	Working Schedule
XBPM	X-ray Beam Position Monitor
XPEEM	X-ray Photoemission Electron Microscopy

COST AND SCHEDULE STATUS

Cost and schedule progress is being tracked using an Earned Value Management System (EVMS) against the cost and schedule baseline established on October 1, 2013. All baseline changes are being controlled through the NEXT Change Control Board. Cost and schedule revisions are being managed using Project Change Control procedures. From June 2015 forward, EAC is reported as the sum of actual cost to date (ACWP) plus the estimated cost to complete (ETC), at the individual activity and resource level, with account-level cost corrections applied as needed to account for the difference between the Earned Value and accrual schedules. ETC values are shown in the final row of the EVMS table below, and all EAC changes are captured in the monthly EAC log.



Cum $M	Jul-15	Aug-15	Sep-15	Oct-15	Nov-15	Dec-15	Jan-16	Feb-16	Mar-16	Apr-16	May-16	Jun-16
BCWS	46.1	48.7	51.7	54.9	58.3	61.5	64.3	66.4	70.7	73.1	75.6	77.5
BCWP	44.5	47.0	50.2	52.8	55.9	58.6	61.2	63.7				
ACWP	46.5	50.7	54.3	56.1	59.8	62.4	64.9	67.2				
SPI	0.97	0.97	0.97	0.96	0.96	0.95	0.95	0.96				
CPI	0.96	0.93	0.93	0.94	0.93	0.94	0.94	0.95				
ETC								18.5	13.3	9.8	6.9	5.3

The NEXT project Schedule Variance (SV) for February 2016 is +$443k, with an associated monthly Schedule Performance Index (SPI) of 1.21 (yellow status). The largest contributors to the current month schedule variance are provided in the table below. The cumulative SPI is 0.96 (green status), 0.01 higher than it was in January.

The NEXT project Cost Variance (CV) for January 2016 is +$105k, with an associated monthly Cost Performance Index (CPI) of 1.05 (green status). The primary contributors to the current month CV are provided in the table below. The cumulative CPI is 0.95 (green status), 0.01 higher than it was in January.

Leading Current Month Variances [$K], February 2016					
WBS	Title	Schedule		Cost	
		SV	Issues	CV	Issues
2.01	Project Support	0	--	-13	-
2.03	Common Systems	29	--	-77	Additional labor and material required, including 3rd photon ESM shutter
2.04	Controls	61	Extra motion controllers and cable earned this month, scheduled earlier	24	--
2.05	ESM systems	25	--	-46	Accrual for KB installation, earned last month
2.06	FXI	12	--	-144	Accrual for shielded enclosure test activities earned last month
2.07	ISR	403	Early earning of HFM, DHRM, KB mirror, and DAQ activities	162	Activities earned but not accrued this month and below-cost-estimate DAQ activities
2.08	ISS	-94	Sum of early (collimating mirror approval) and late (sample chamber receipt) activities	34	--
2.09	SIX	14	--	87	Late accruals on 3 contracts: spectrometer arm, sample chamber, sample manipulator
2.10	SMI	-102	Late PDS assembly and installation activities	-20	--
2.11	Insertion Devices	86	Early EV for ESM EPU57 receipt and late EV for SIX EPU57 contract FAT	58	Late accrual for SIX EPU57 contract FAT
2.12	ID & FE Install	0	--	46	Corrections to earlier labor charges
	Total	**433**	**Total**	**109**	

As of February 29, 2016, the project is 77.4% complete with 41.4% contingency ($7.7M) for $18.6M Budget At Completion (BAC) work remaining, based on PCRs processed and approved through February 2016. The project EAC for February is reported at $85,738k against a Performance Measurement Baseline (PMB)/Undistributed Budget (UB) of $82,305k. The Variance At Completion (VAC) is given by VAC = BAC – EAC, with EAC = ACWP + ETC. Through February 2016, the

VAC (-$3,433k) is nearly equal to the cumulative cost variance (-$3,519k), which is in turn dominated by labor cost overage on work performed to date.

The February 2016 EAC ($85.74M) is $0.14M lower than the January value. As of the end of February, contingency on EAC is $4.26M, which represents 23.0% of $18.5M EAC work remaining. Outstanding commitments total $10.6M, so the $4.26M contingency on EAC represents 54.3% of $7.9M unobligated EAC work to go. ETC will continue to be assessed monthly through project completion to contain costs while maintaining the good schedule performance that the project has demonstrated to date.

Three PCRs were approved and implemented in February.

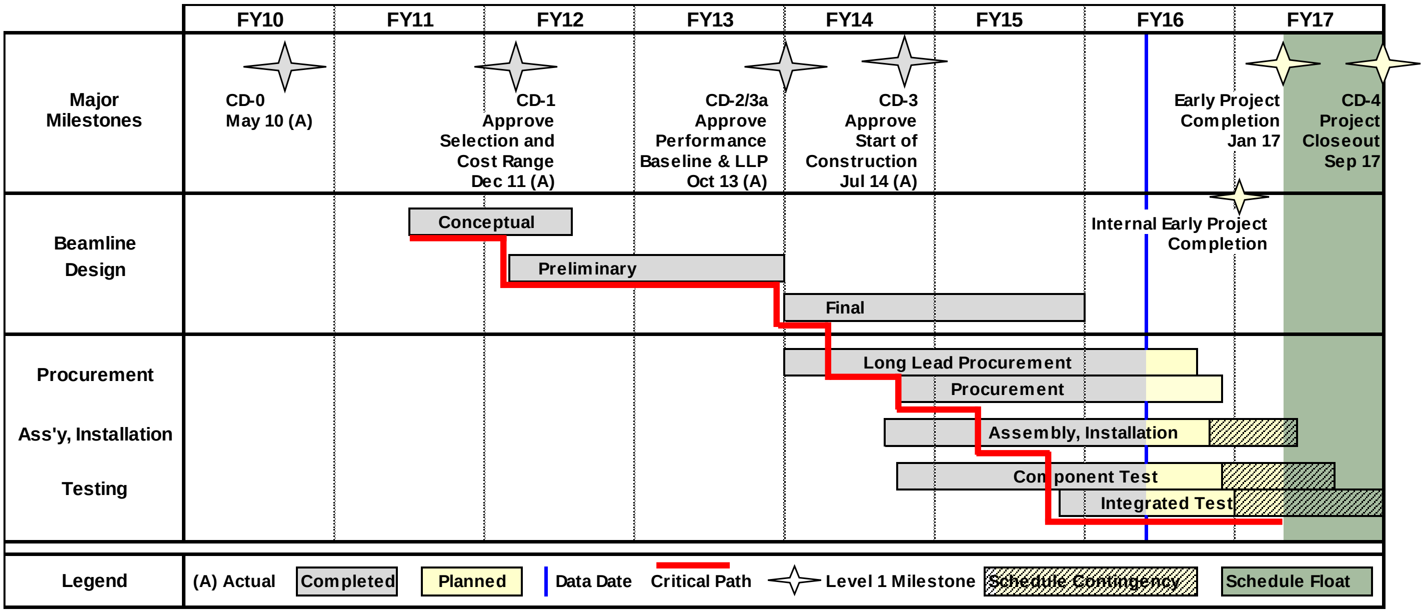
PCR	PCR Level	Baseline Change [$]	Description
16-110	L3	-52	EPU contract amendment, power supply procurement adjustments
16-111	L3	57	ISS Gas Handling System & Sample Chamber contract amendments
16-112	L2	0	Revisions to schedule milestones

One PCR is planned in March: PCR_16_113, a zero-cost Level 3 PCR in WBS 2.08.02 (ISS Beamline Systems) to implement an amendment to the ISS Spectrometer System contract.

NEXT as of 2/29/2016	Current Period	Cum-to-Date
Plan (BCWS) $k	2,029	66,378
Earned (BCWP) $k	2,462	63,702
Actual (ACWP) $k	2,353	67,221
SV $k	433	-2,675
CV $k	109	-3,519
SPI	1.21	0.96
CPI	1.05	0.95
Budget at Completion $k (PMB [UB])		82,305
Planned % Complete (BCWS/BAC)		80.6%
Earned % Complete (BCWP/BAC)		77.4%
Contingency $k		7,695
Contingency / (BAC – BCWP)		41.4%
EAC $k		85,738
Contingency / (EAC – BCWP)		34.9%
(Contingency + VAC) / (EAC – ACWP)		23.0%
TPC = PMB + Contingency		90,000

Milestones – Near Term		Planned	Actual
L2	Receive 1st Double Crystal X-ray Monochromator	16-Feb-16	30-Sep-15
L3	ISR - Bench test of Dual Phase Plate Assembly complete	24-Feb-16	4-Mar-16
L3	SIX - Testing Monochromator and Slits complete	1-Mar-16	Expect May
L3	ESM - Photon Delivery System Ready for Integration	7-Mar-16	
L3	ISR - Installation of DCM Monochromator complete	15-Mar-16	Expect May
L3	Common Beamline Systems: Electrical Utilities Installed	29-Apr-16	
L3	ESM - Testing Monochromator and Slits complete	12-May-16	Expect April
L2	Complete Installation of 1st Beamline Components	25-May-16	
L2, L3	Common Beamline Systems: Mechanical Utilities Installed	31-May-16	
L3	Insertion Devices - SIX EPU Received	6-Jun-16	2-Mar-16
L3	SMI - Installation of CRL Focusing Optics Complete	17-Jun-16	24-Mar-16
L3	ISR – Installation of Beamline Components Complete	29-Jun-16	
L3	ISS - Testing Collimating Mirror complete	7-Jul-16	
L2	Receive EPUs for ESM and SIX	12-Aug-16	
L3	Insertion Devices - ESM EPU105 Received	12-Aug-16	
L3	SIX - Testing of Spectrometer Detector Complete	23-Aug-16	
L3	WBS 2.04 – Beamline Control Systems Complete	14-Sep-16	
L3	ISS – Installation of Beamline Components Complete	14-Sep-16	
L3	SMI – Installation of Beamline Components Complete	16-Sep-16	
L3	ESM – Installation of Beamline Components Complete	29-Sep-16	
L3	SIX – Installation of Beamline Components Complete	30-Sep-16	
L3	Common Beamline Systems: EPS Installed	30-Sep-16	
L2, L3	Complete Installation of Common Beamline Systems PPS	30-Sep-16	
L2	1st Beamline Available	30-Sep-16	Expect April
L2	Early Project Completion – incl. IRR	31-Jan-17	

PROJECT SCHEDULE



The project critical path runs through activities in WBS 2.09 (SIX beamline). As of February 2016, the active critical path runs through fabrication, assembly, testing, delivery, installation, and phase 1 commissioning (including controls) of the SIX Beamline Spectrometer Arm System.

Staffing Report

Staffing as of 2/29/2016	Current Period		Cumulative-to-Date	
	Planned ** (FTE-yr)	Actual (FTE-yr)	Planned ** (FTE-yr)	Actual (FTE-yr)
WBS 2.01 Project Management and Support	0.66	0.57	34.34	31.70
WBS 2.02 Conceptual and Advanced Conceptual Design	0.00	0.00	8.74	8.74
WBS 2.03 Common Beamline Systems	1.00	1.11	23.60	11.35 *
WBS 2.04 Control System	0.60	0.68	16.38	15.69
WBS 2.05 ESM Beamline	0.38	0.55	13.53	14.30
WBS 2.06 FXI Beamline	0.01	0.00	4.77	4.58
WBS 2.07 ISR Beamline	0.71	0.39	13.28	11.94
WBS 2.08 ISS Beamline	0.67	0.56	12.76	12.45
WBS 2.09 SIX Beamline	0.40	0.66	15.55	18.40
WBS 2.10 SMI Beamline	0.68	0.37	12.82	12.00
WBS 2.11 Insertion Devices	0.05	0.22	4.34	3.93
WBS 2.12 ID & FE Installation	0.00	0.00	3.88	7.97
Total	**5.16**	**5.11**	**163.99**	**153.05**

** Based on the NEXT working schedule

* A large fraction of utilities installation has been performed by contractors (M&S) rather than staff as originally planned

Number of individuals who worked on NEXT during February 2016: 126

Funding Profile

Funding Type	NEXT Funding Profile ($M)						
	FY11	FY12	FY13	FY14	FY15	FY16	Total
OPC	3.0						3.0
TEC – Design		3.0	2.0				5.0
TEC – Fabrication		9.0	10.0	25.0	22.5	15.5	82.0
Total Project Cost	**3.0**	**12.0**	**12.0**	**25.0**	**22.5**	**15.5**	**90.0**

Key NEXT Personnel

Title	Name	Email	Phone
Federal Project Director	Robert Caradonna	rcaradonna@bnl.gov	631-344-2945
NEXT Project Manager	Steve Hulbert	hulbert@bnl.gov	631-344-7570

COST PERFORMANCE REPORT

	CONTRACT PERFORMANCE REPORT FORMAT 1 - WORK BREAKDOWN STRUCTURE		$	FORM APPROVED OMB No. 0704-0188
1. CONTRACTOR	2. CONTRACT		3. PROGRAM	4. REPORT PERIOD
a. NAME Brookhaven National Laboratory	a. NAME NEXT		a. NAME NSLS-II Experimental Tools (NEXT) Project	a. FROM *(YYYYMMDD)* 2016 / 02 / 01
b. LOCATION (Address and ZIP Code)	b. NUMBER		b. PHASE	b. TO *(YYYYMMDD)* 2016 / 02 / 29
	c. TYPE	d. SHARE RATIO	c. EVMS ACCEPTANCE X YES	

WBS (2) WBS (3) ITEM (1)	CURRENT PERIOD BUDGETED COST WORK SCHEDULED (2)	 WORK PERFORMED (3)	 ACTUAL COST WORK PERFORMED (4)	 VARIANCE SCHEDULE (5)	 COST (6)	CUMULATIVE TO DATE BUDGETED COST WORK SCHEDULED (7)	 WORK PERFORMED (8)	 ACTUAL COST WORK PERFORMED (9)	 VARIANCE SCHEDULE (10)	 COST (11)	AT COMPLETION BUDGETED (14)	 ESTIMATED (15)	 VARIANCE (16)
2.01 Project Management and Support	161,039	161,039	174,155	0	(13,117)	8,018,162	8,018,162	8,786,091	0	(767,929)	9,918,232	10,575,950	(657,718)
2.01.01 Project Management	68,594	68,594	72,989	0	(4,395)	3,777,473	3,777,473	3,535,658	0	241,814	4,598,029	4,361,153	236,875
2.01.02 Project Support	92,445	92,445	101,167	0	(8,721)	4,240,689	4,240,689	5,250,432	0	(1,009,743)	5,320,204	6,214,797	(894,593)
2.02 Conceptual Design and Advanced Conceptual Design	0	0	0	0	0	1,807,316	1,807,316	1,807,316	0	0	1,807,316	1,807,316	0
2.03 Common Beamline Systems	103,693	132,239	209,491	28,546	(77,252)	5,754,707	5,664,189	6,910,517	(90,517)	(1,246,328)	7,212,607	8,534,430	(1,321,822)
2.03.01 Utilities	26,866	29,208	36,778	2,342	(7,569)	4,190,914	3,808,234	3,973,102	(382,681)	(164,868)	4,209,423	4,403,269	(193,847)
2.03.02 Personnel Protection System (PPS)	64,717	25,879	97,938	(38,838)	(72,059)	703,138	817,700	1,612,385	114,562	(794,685)	1,523,306	2,313,402	(790,096)
2.03.03 Equipment Protection System (EPS)	4,399	28,505	38,903	24,106	(10,398)	335,980	433,928	692,595	97,948	(258,666)	680,294	988,944	(308,650)
2.03.04 Control Station	0	41,826	23,960	41,826	17,867	93,100	175,422	112,575	82,322	62,847	306,744	244,338	62,406
2.03.05 Common Beamline Systems Management	7,711	6,821	11,913	(890)	(5,092)	431,575	428,905	519,860	(2,670)	(90,955)	492,840	584,476	(91,636)
2.04 Control System	97,478	158,346	134,029	60,868	24,317	3,892,386	3,880,502	3,943,568	(11,884)	(63,065)	4,558,236	4,661,058	(102,822)
2.04.01 Control System Management	4,727	4,727	24,066	0	(19,339)	247,532	247,532	224,473	0	23,059	294,427	271,272	23,155
2.04.02 Control System Design & Implementation	92,750	73,209	100,300	(19,541)	(27,091)	2,294,632	2,353,657	2,496,983	59,025	(143,326)	2,913,586	3,110,632	(197,046)
2.04.03 Control System Equipment	0	80,409	9,663	80,409	70,747	1,350,223	1,279,314	1,222,112	(70,909)	57,202	1,350,223	1,279,154	71,069
2.05 ESM Beamline	218,943	243,835	289,743	24,892	(45,908)	8,933,506	8,316,116	8,756,960	(617,390)	(440,844)	9,289,079	9,585,516	(296,437)
2.05.01 ESM Management	13,295	13,295	5,746	0	7,549	494,320	494,320	441,415	0	52,905	626,650	561,146	65,504
2.05.02 ESM Beamline Systems	205,647	230,539	283,996	24,892	(53,457)	8,439,186	7,821,796	8,315,546	(617,390)	(493,750)	8,662,429	9,024,370	(361,941)
2.06 FXI Beamline	0	11,575	155,497	11,575	(143,921)	1,818,324	1,818,324	1,791,546	0	26,778	1,818,324	1,791,546	26,778
2.06.01 FXI Management	0	0	0	0	0	409,359	409,359	470,908	0	(61,549)	409,359	470,908	(61,549)
2.06.02 FXI Beamline Systems	0	11,575	155,497	11,575	(143,921)	1,408,965	1,408,965	1,320,638	0	88,327	1,408,965	1,320,638	88,327
2.07 ISR Beamline	422,797	826,265	664,716	403,468	161,550	6,897,179	6,617,892	6,735,948	(279,287)	(118,056)	10,361,410	10,464,058	(102,648)
2.07.01 ISR Management	26,199	26,199	23,395	0	2,804	863,407	863,407	859,629	0	3,778	1,105,394	1,042,935	62,460
2.07.02 ISR Beamline Systems	396,598	800,066	641,321	403,468	158,745	6,033,772	5,754,485	5,876,319	(279,287)	(121,835)	9,256,015	9,421,123	(165,108)
2.08 ISS Beamline	521,446	427,148	393,617	(94,298)	33,531	8,693,644	8,817,536	9,402,630	123,892	(585,094)	10,472,212	11,045,644	(573,432)
2.08.01 ISS Management	12,312	26,422	16,352	14,110	10,070	606,991	663,431	593,080	56,441	70,351	838,199	744,831	93,368
2.08.02 ISS Beamline Systems	509,134	400,726	377,265	(108,408)	23,461	8,086,653	8,154,105	8,809,550	67,452	(655,445)	9,634,013	10,300,814	(666,801)
2.09 SIX Beamline	242,999	256,682	169,613	13,683	87,070	8,934,835	7,363,600	7,929,343	(1,571,236)	(565,743)	11,572,208	12,283,701	(711,493)
2.09.01 SIX Management	17,355	17,355	23,448	0	(6,093)	575,256	575,256	593,423	0	(18,166)	729,841	747,292	(17,451)
2.09.02 SIX Beamline Systems	225,644	239,327	146,164	13,683	93,163	8,359,579	6,788,343	7,335,920	(1,571,236)	(547,577)	10,842,367	11,536,409	(694,042)
2.10 SMI Beamline	243,206	141,125	161,572	(102,081)	(20,446)	7,046,573	6,707,122	6,817,104	(339,452)	(109,982)	9,108,910	9,092,755	16,155
2.10.01 SMI Management	10,718	10,718	14,643	0	(3,925)	646,926	646,926	558,888	0	88,038	802,179	712,072	90,108
2.10.02 SMI Beamline Systems	232,489	130,408	146,929	(102,081)	(16,521)	6,399,647	6,060,196	6,258,216	(339,452)	(198,020)	8,306,731	8,380,684	(73,953)
2.11 Insertion Devices	17,405	103,829	46,164	86,424	57,666	3,128,085	3,238,923	2,887,336	110,837	351,587	4,733,509	4,443,168	290,341
2.11.01 ESM EPU Insertion Device	14,951	101,375	38,990	86,424	62,385	2,937,894	3,048,731	2,745,501	110,837	303,230	4,515,912	4,273,978	241,934
2.11.02 SIX EPU Insertion Device	0	0	0	0	0	117,137	117,137	70,375	0	46,762	117,137	70,375	46,762
2.11.03 Insertion Devices Management	2,455	2,455	7,173	0	(4,719)	73,055	73,055	71,461	0	1,594	100,460	98,816	1,644
2.12 ID & FE Installation & Testing	0	0	(45,568)	0	45,568	1,452,816	1,452,816	1,452,960	0	(143)	1,452,816	1,452,816	(0)
2.12.01 ID & FE Installation & Testing Management	0	0	0	0	0	20,739	20,739	20,739	0	0	20,739	20,739	0
2.12.02 ID Installation & Testing	0	0	(35,065)	0	35,065	584,560	584,560	584,560	0	(0)	584,560	584,560	(0)
2.12.03 FE Installation & Testing	0	0	(10,503)	0	10,503	847,517	847,517	847,660	0	(143)	847,517	847,517	0
Total Project Baseline	**2,029,007**	**2,462,085**	**2,353,027**	**433,078**	**109,058**	**66,377,534**	**63,702,498**	**67,221,318**	**(2,675,036)**	**(3,518,820)**	**82,304,860**	**85,737,959**	**(3,433,098)**
Undistributed Budget													
Management Reserve													
Performance Management Baseline - PMB	**2,029,007**	**2,462,085**	**2,353,027**	**433,078**	**109,058**	**66,377,534**	**63,702,498**	**67,221,318**	**(2,675,036)**	**(3,518,820)**	**82,304,860**	**85,737,959**	**(3,433,098)**